भारतीय मानक **IS 1121 (Part 3) : 2023**

Indian Standard

प्राकृतिक इमारती पत्थर के सामर्थ्य गुणों को ज्ञात करना — परीक्षण पद्धतियाँ

भाग 3 अप्रत्यक्ष तनन क्षमता

(तीसरा पुनरीक्षण)

Determination of Strength Properties of Natural Building Stones — Methods of Test

Part 3 Indirect Tensile Strength

(Third Revision)

ICS 91.100.15

भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
मानक भवन, 9 बहादुर शाह ज़फर मार्ग, नई दिल्ली - 110002
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI - 110002
www.bis.gov.in www.standardsbis.in

November 2023 **Price Group 5**

Stones Sectional Committee, CED 06

FOREWORD

This Indian Standard (Part 3) (Third Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Stones Sectional Committee had been approved by the Civil Engineering Division Council.

Building stones are available in large quantity in various parts of the country and to choose and utilize them for their satisfactory performance, it is necessary to know the various strength properties determined according to standard procedure. This standard has, therefore, been formulated to cover the standard method for determining the strength properties of various stones. This standard covering compressive, transverse and shear strength properties was published in 1957 and was subsequently revised in 1974 and in 2013. The revision in 1974 was issued in four parts, other parts being:

Part 1 Uniaxial Compressive strength
Part 2 Transverse strength
Part 4 Shear strength

All four parts of IS 1121 are being revised. In doing so, another part namely, Part 5 'Flexural modulus of elasticity' is being introduced.

In the previous revision of the standard, the surface finishing requirement had been modified, vacuum saturation in water had been specified instead of conditioning by normal immersion, rate of loading had been modified, and the minimum number of test specimens had been modified.

This standard is brought out to incorporate the experience gained based on the use of the standard since its last revision. The major modifications incorporated in this revision are as follows:

a) The title of the standard has been modified to specify indirect testing;
b) The criteria for valid test results have been modified;
c) The figure for general testing arrangement has been updated; and
d) A sample test report has been included.

This standard contributes to the United Nations Sustainable Development Goal 11 'Sustainable cities and communities' towards strengthening efforts to protect and safeguard the world's cultural and natural heritage.

The composition of the Committee responsible for formulation of this standard is given in Annex B.

In reporting the results of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

DETERMINATION OF STRENGTH PROPERTIES OF NATURAL BUILDING STONES — METHODS OF TEST
PART 3 INDIRECT TENSILE STRENGTH

(Third Revision)

1 SCOPE

This standard (Part 3) lays down the procedure for determination of split tensile strength of natural building stones used for constructional purposes.

2 REFERENCE

The standard given below contains provision, which through reference in this text, constitutes provision of this standard. At the time of publication, the edition indicated was valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of this standard:

IS No.	*Title*
IS 9179 : 1979	Method for preparation of rock specimen for laboratory testing

3 SELECTION OF SAMPLES

3.1 The sample shall be selected to represent a true average of the type or grade of stone under consideration.

3.2 The sample shall be selected from the quarried stone or taken from the natural rock, as described in **3.2.1** and **3.2.2** and shall be of adequate size to permit the preparation of the requisite number of test specimens.

3.2.1 *Stones from Ledges or Quarries*

The ledge or quarry face of the stone shall be inspected to determine any variation in different strata. Differences in colour, texture and structure shall be observed. Separate samples of stone of adequate size of the unweathered specimens shall be obtained from all strata that appear to vary in colour, texture and structure. Specimens that have been damaged by blasting, driving wedges, heating, etc shall not be included in the sample.

3.2.2 *Field Stone and Boulders*

A detailed inspection of the stone and boulders over the area shall be made where the supply is to be obtained. The different kinds of stones and their conditions at various quarry sites shall be recorded. Separate samples for each class of stone that would be considered for use in construction as indicated by visual inspection shall be selected.

3.3 When perceptible variations occur in the quality of rock, as many samples as are necessary for determining the range in properties shall be selected.

4 TEST SPECIMENS AND CONDITIONING

4.1 Test specimens shall be made from samples selected in accordance with **3** and shall be in the form of cylinders. They shall be drilled from the samples. The diameter of the test specimen shall be not less than 50 mm and the ratio of diameter to height shall be 1 : 2.

4.2 The specimen shall be prepared in accordance with IS 9179.

4.3 Five test specimens shall be used for conducting the test in each of the conditions mentioned in **4.3.1** and **4.3.2**.

4.3.1 The test specimens shall be saturated by vacuum saturation by immersing in water maintained at 20 °C to 30 °C in an evacuation vessel under a vacuum of about 50 mm of Hg to 100 mm of Hg. Specimens shall be initially immersed continuously for about 4 h to 5 h in vacuum and then its mass is measured at an interval of 1 h (sample being replaced back in evacuation vessel after weighing) till constant mass. Constant mass is considered to have been achieved when two consecutive hourly measurement of mass do not vary by more than 0.1 percent of the saturated mass. Vacuum may be created by a suitable air suction pump.

4.3.2 The test specimens shall also be tested in a dry condition and shall be dried in an oven at 70 °C ± 5 °C for 48 h and cooled in a desiccator to room temperature (20 °C to 30 °C) to constant mass. Constant mass is considered to have been achieved when two consecutive hourly

measurement of mass do not vary by more than 0.1 percent.

5 APPARATUS

A testing machine of sufficient capacity for the tests and capable of applying load at the specified rate shall be used. The machine shall be equipped with two steel bearing plates not less than 10 mm thick with hardened faces. One of the plates (preferably the one that normally bears on the upper surface of the test specimens) shall be fitted with a ball seating in the form of a portion of a sphere, the centre of which coincides with the central point of the face of the plate. The other compression plate shall be plain rigid bearing block. The bearing faces of both plates shall be of width greater than 25 mm and the length at least equal to the length of the test specimen. The bearing surface of the plates when new, shall not depart from a plane by more than 0.012 5 mm at any point. The movable portion of spherically seated compression plate shall be held on the spherical seat, but the design shall be such that it is possible to rotate the bearing face freely and tilt it through small angles in any direction.

6 PROCEDURE

Each test specimen to be tested is sandwiched in between two steel plates of width 25 mm, thickness 10 mm and length equal to the length of test specimen (*see* Fig. 1). The load shall be applied without shock and increased continuously at a uniform rate of 200 N/s until the specimen splits and no greater load is sustained. The maximum load applied to the specimen shall be recorded, in N, with 1 percent accuracy.

7 EVALUATION AND REPORT OF TEST RESULTS

The split tensile strength of the specimen shall be calculated as follows:

$$S = \frac{2W}{\pi dL}$$

where

S = split tensile strength, in N/mm^2;

W = applied load, in N, at which specimen splits;

d = diameter of specimen, in mm; and

L = length of specimen, in mm.

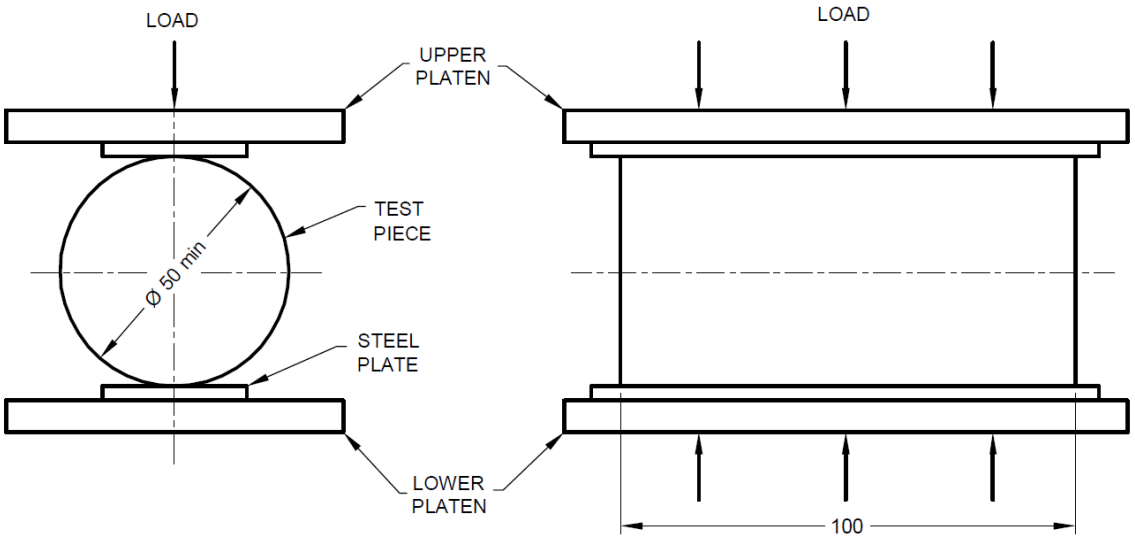
The average of all the five results separately for each condition (wet and dry) shall be taken as the split tensile strength of the sample.

The individual and average of the five valid results in each condition separately (*see* **4.3**) shall be taken for purposes of reporting the split tensile strength of the sample having the individual variation not more than ± 15 percent of the average. Additional samples shall be tested in place of invalid results.

7.1 The split tensile strength of the sample shall be expressed in N/mm^2, in three significant figures.

7.2 Identification of the sample, date when the sample was taken and type of the stone shall be reported. A sample format of test report is attached at Annex A.

7.3 The size and shape of test specimen used in the tests shall be indicated.



All dimensions in millimetres.

FIG. 1 GENERAL ARRANGEMENT FOR TESTING TENSILE STRENGTH OF BUILDING STONE

ANNEX A

(*Clause* 7.2)

SAMPLE FORMAT FOR TEST REPORT FOR INDIRECT TENSILE TEST OF STONES

Inward No.: Sample No.: Date:

Sample pre-treatment for saturated conditions:

Sub Sample No.	Mass of Sample in Saturated Surface Wet Condition				Final mass in SSD condition
	1	2	3	4	
01					
02					
05					

Sample pre-treatment for dry conditions:

Sub Sample No.	Mass of Sample in Hot Condition				Final Mass After Cooling
	1	2	3	4	
06					
07					
10					

Test in dry/wet condition for load applied perpendicular to the plane of foliation, cleavage, rift or bedding.

Span between the support (L): _____ mm.

Sub Sample No.	Width at Failure Section (b)	Depth at Failure Section (d)	Central breaking Load in N (W)	Transverse Strength (R) in N/mm^2 WL/bd^2	Validity* of Result Yes/No	Average Transverse Strength of 5 Valid Results Under each Conditioning
01						
02						
10						
* Valid results are those which falls within 15 percent of the average of 5 results of each type of conditioned sample.						

Sr No.	Load Applied in kN	Support Dial Gauge Reading		Mid-Span Dial Gauge Readings		Net Deflection Δ
		s_1	s_2	c_1	c_2	
01						
02						
03						
10						

ANNEX B

(*Foreword*)

COMMITTEE COMPOSITON

Stones Sectional Committee, CED 06

Organization	*Representative(s)*
Indian Institute of Technology Delhi, New Delhi	DR SHASHANK BISHNOI **(*Chairperson*)**
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In Personal Capacity (*B-208, Sushant Lok-1, Gurugram - 122009*)	MS BHAWNA DANDONA
In Personal Capacity (*Flat 119, Amulya Fortune Apartments Road No1, Opp. Union Bank, Madhavapuri Hills, Chandanagar - 500050*)	SHRI KOTA SITARAMANANJEYULU
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BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones: 2323 0131, 2323 3375, 2323 9402 *Website*: www.bis.gov.in

Regional Offices:		*Telephones*
Central	: 601/A, Konnectus Tower -1, 6th Floor, DMRC Building, Bhavbhuti Marg, New Delhi 110002	2323 7617
Eastern	: 8th Floor, Plot No 7/7 & 7/8, CP Block, Sector V, Salt Lake, Kolkata, West Bengal 700091	2367 0012 2320 9474
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